Reports indicate that approximately 46 percent of Afghanistan's irrigated cropland is given to high value horticulture crops. Moreover, poppy production is concentrated largely in the major wheat producing areas of Helmand-Arghandab Valley. These factors suggest that poppy cultivation may significantly affect the evaluation of wheat availability.

DAI, under the Narcotics Awareness and Control Project, prepared a report for O/AID/REP on the feasibility of identifying the poppy signature in Afghanistan.[8] The report concluded that identification of the poppy signature could be accomplished under certain conditions (e. g., large scale cultivation, minimal mixed cropping). The spring 1991 ground truth exercise indicated that these conditions prevail in large areas of Ningarhar, Kandahar, and Helmand provinces.

Refugee Repatriation from Iran

The DAI/EarthSat team is currently in possession of population estimates and origins only for those Afghan refugees resident in Pakistan. However, the majority of inhabitants of the provinces in the west, northwest, and central highlands of the Afghanistan who fled the country settled in Iran. Thus, this study demonstrates relatively minor effects of refugee repatriation to these areas. Information on the province of origin for Afghan refugees settled in Iran is needed to systematically assess the impact of repatriation on wheat availability in 1992 and beyond. The UNHCR may be able to provide data on Afghan refugee population in Iran.

Internally Displaced Refugees

The estimates for Kabul used in this study province reflect a substantial population increase due to the influx of internally displaced persons. Additional information on the origins of these persons, as well as numbers and origins of persons who have relocated to other urban areas, is needed to evaluate the impact of internally displaced persons on wheat availability.

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[8] Steven A. Sader, *Remote Sensing of Narcotics: with Special Reference to Techniques for Detection and Monitoring of Poppy Production in Afghanistan*, DAI/NACP, September 1990; Kerry Connor, *Pilot Project for Poppy Identification with Remotely-Sensed Data*, DAI/NACP, August 1991.

Transport Infrastructure Information

The analysis of the potential for movement of wheat from surplus to deficit areas requires more current and detailed infrastructure information. The choice of the most appropriate option for meeting food needs in deficit areas will require information on effective distances[9] and feasible means of transport. Current costs of transport from point to point provided another means of evaluating transport conditions.

Trading Practices

Evaluation of the potential to supply wheat to significant deficit areas from surplus areas requires information on recent grain export practices. Data are needed from a representative sample of farmers, local grain cooperatives, and (where appropriate) local political entities on topics such as the amount of grain kept for household use, the amount of grain stored in granaries and for mandawees (grain bazaars), the average prices paid for grain exports, and the primary destinations of grain exports.

Incremental Refugee Return

Refugees from some parts of Afghanistan (e. g., people from border areas in the east and south) are more likely to return during the next year or two than are those from other areas. We may wish to focus our efforts first on understanding food needs by upgrading the database with more accurate refugee numbers and infrastructure information for these areas.

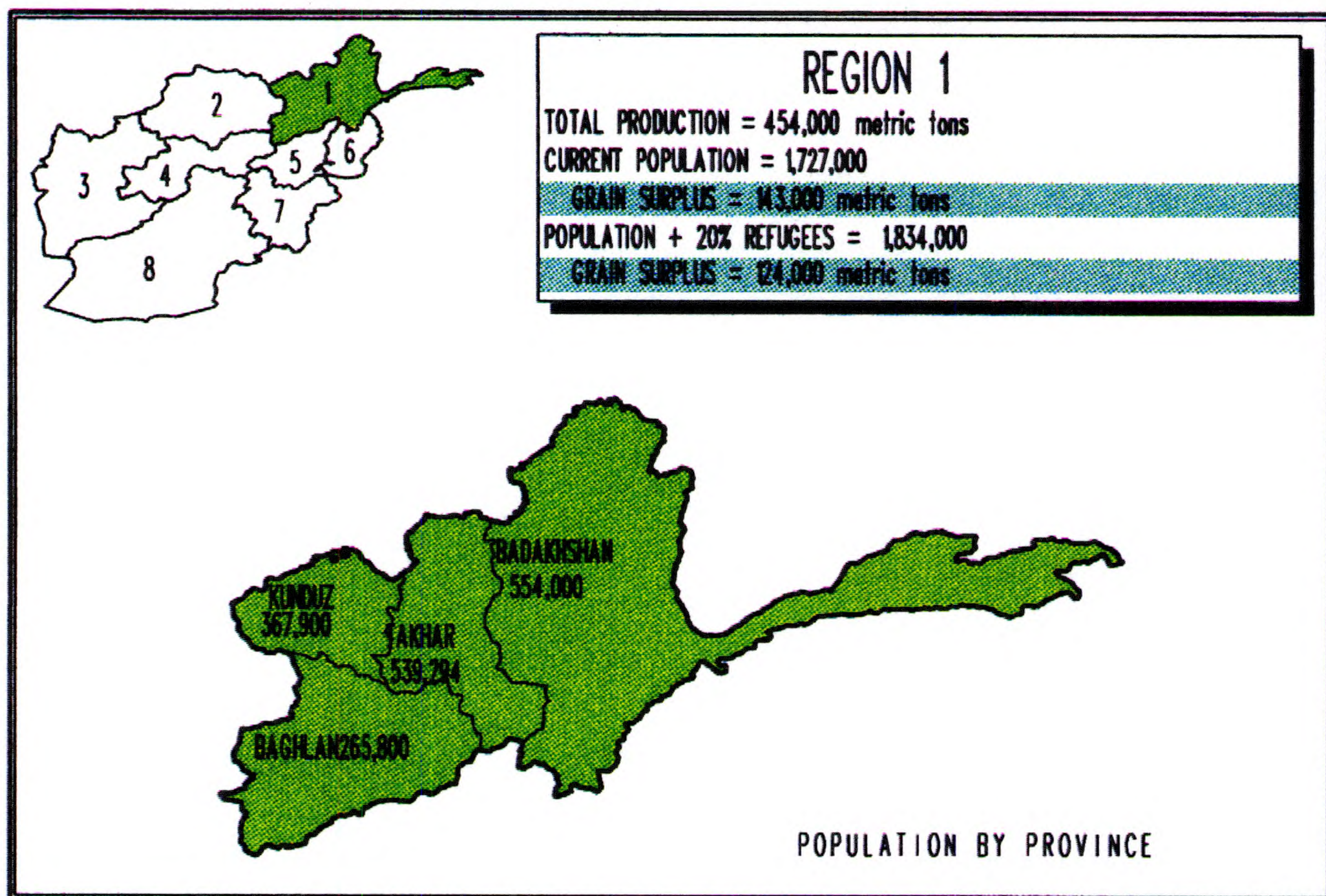
[9] Effective distance refers to the actual time required to travel from point A to point B. In the context of grain shipment, the effective distance must also consider the time required for the appropriate type of vehicle loaded with grain.

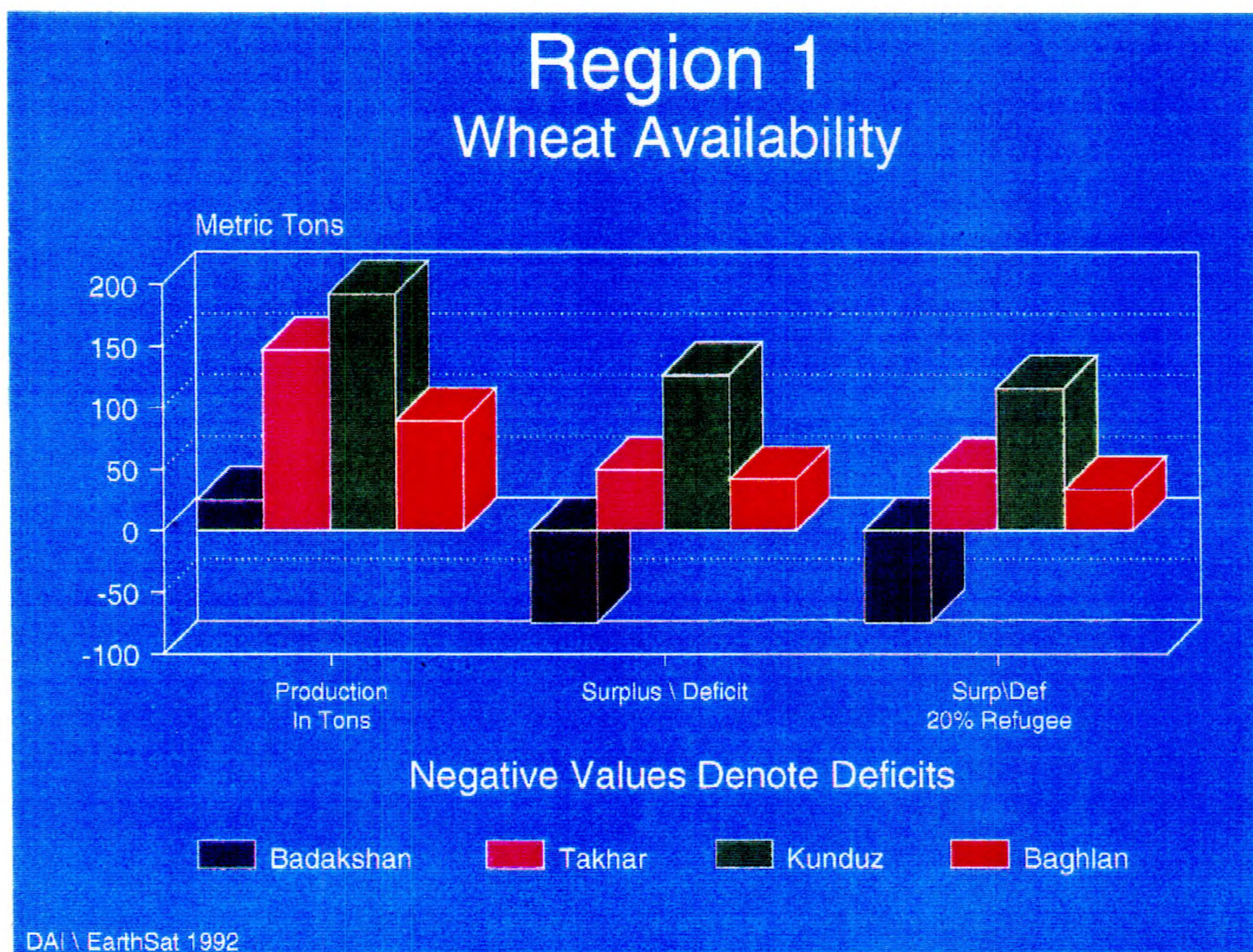
APPENDIX I

The maps and charts presented in this appendix depict the surplus and deficit grain conditions in each of the eight regions. For each region and provinces encompassed in each region, the maps show (in the following order):

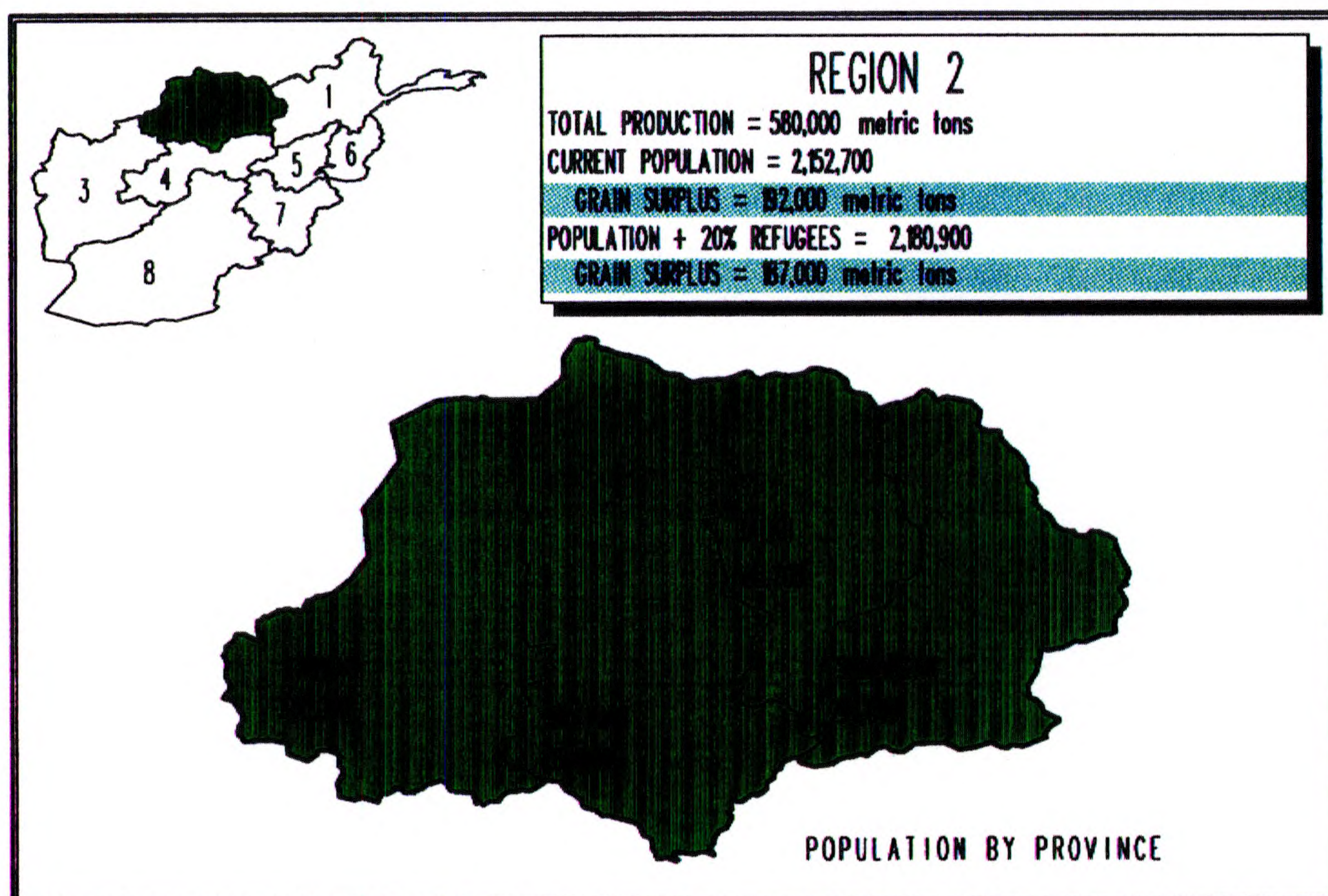
- wheat production estimates in metric tons;
- number of persons who can be fed by the wheat produced (at 15 kgs per person/per month);
- estimates of current population;
- wheat surpluses and deficits (in metric tons) based on yield/persons/15 kgs per month.

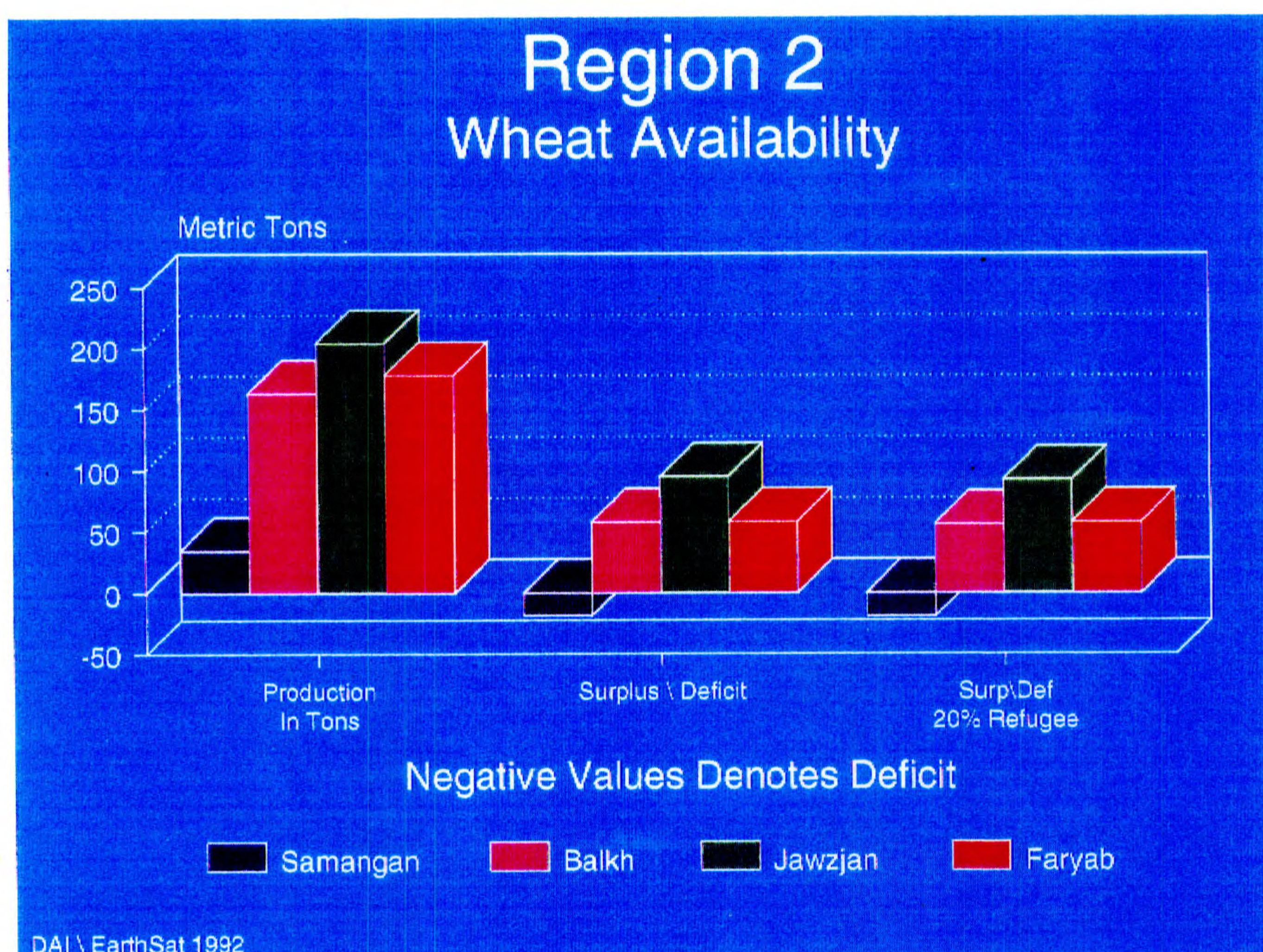
Region 1: Kunduz, Takhar, Baghlan, Badakhshan



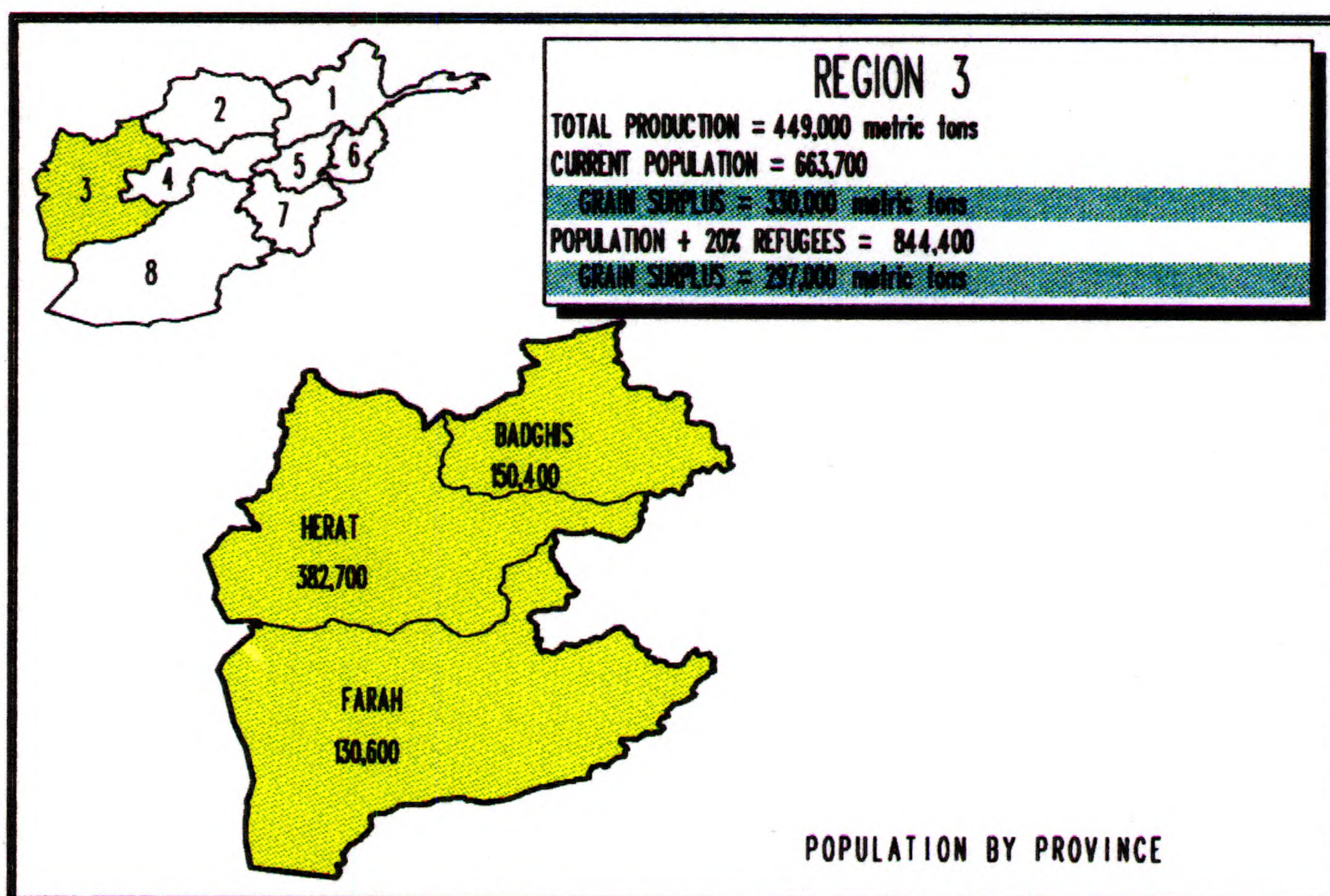


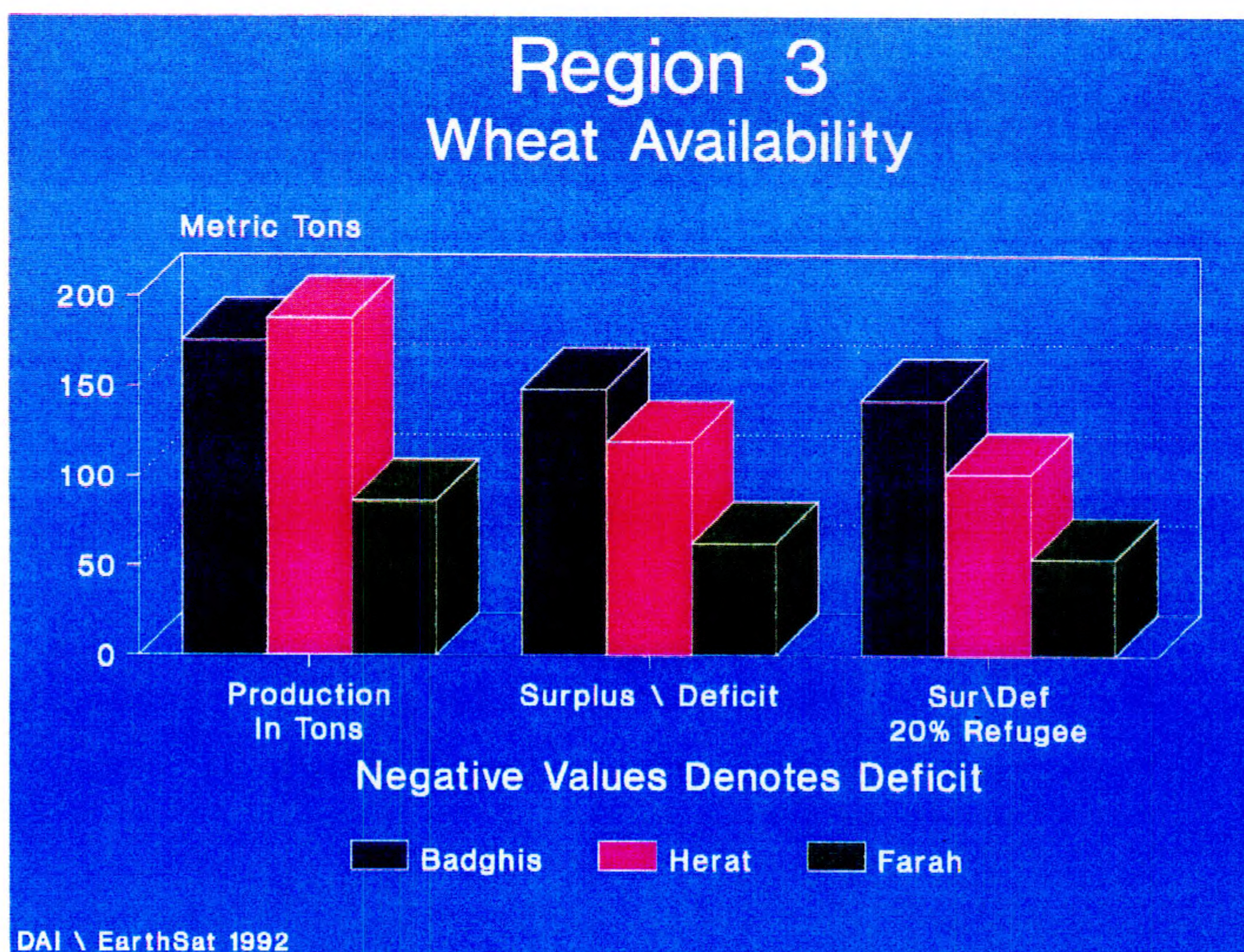
Region 2: Jawzjan, Balkh, Faryab, Samangan



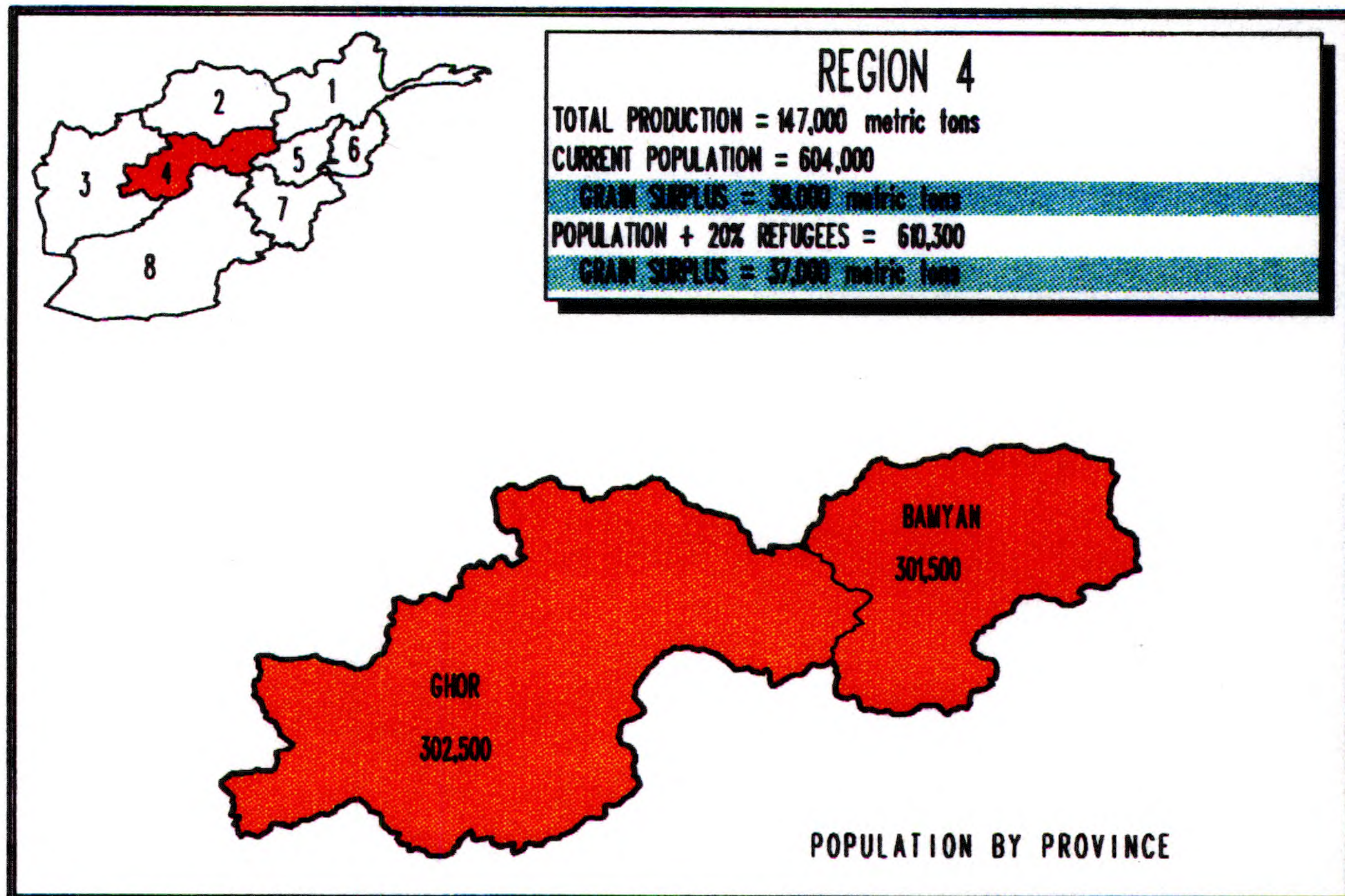


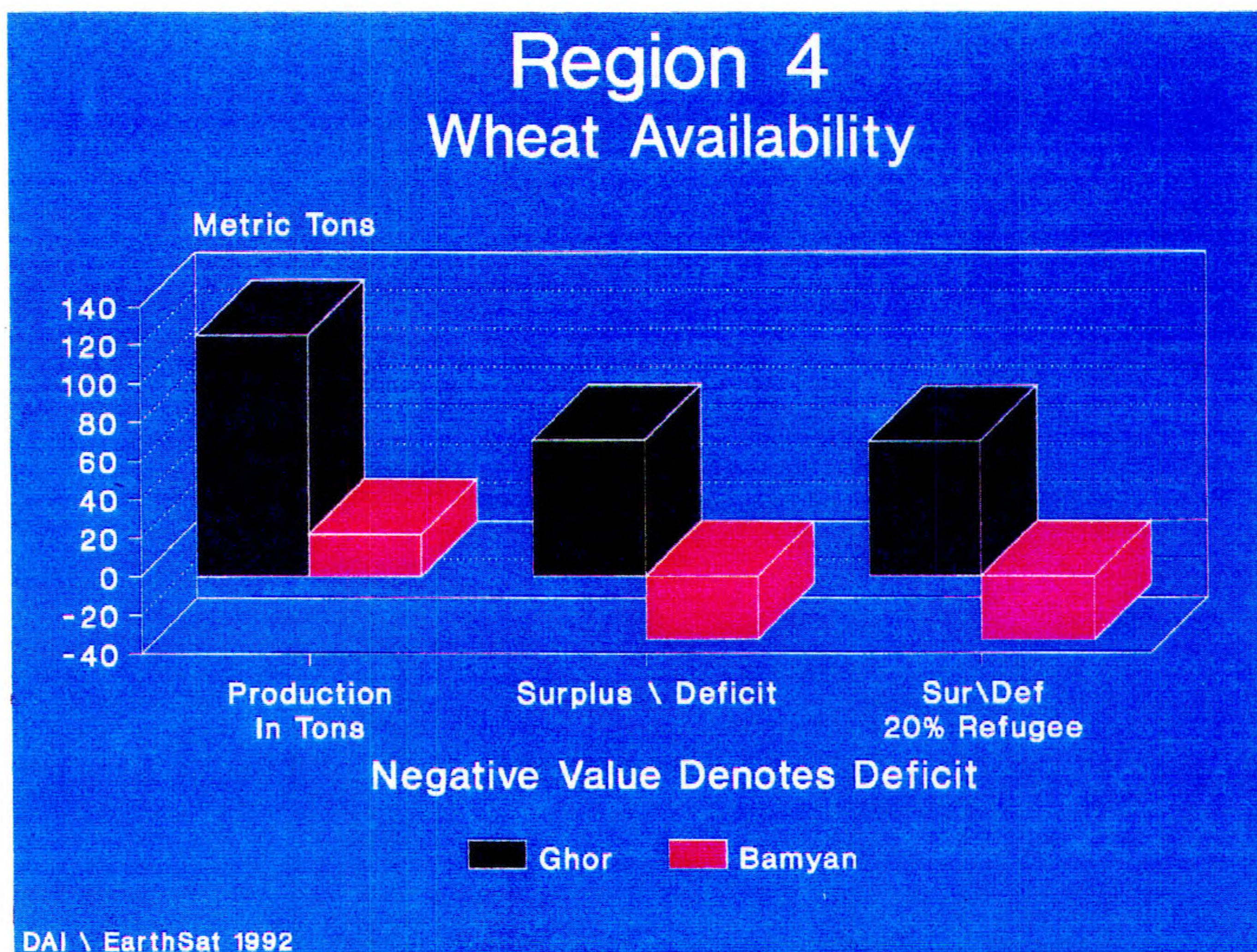
Region 3: Farah, Herat, Badghis



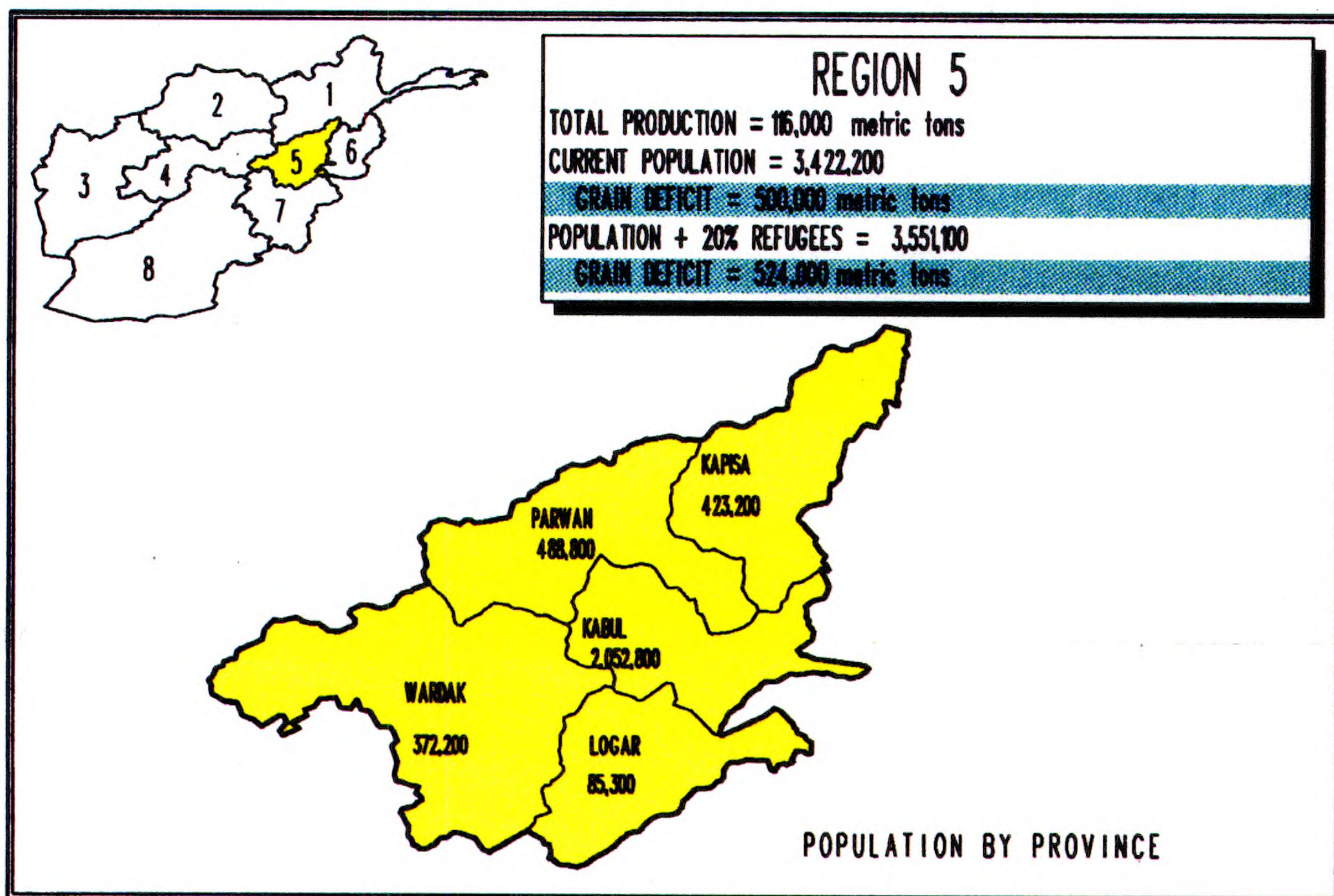


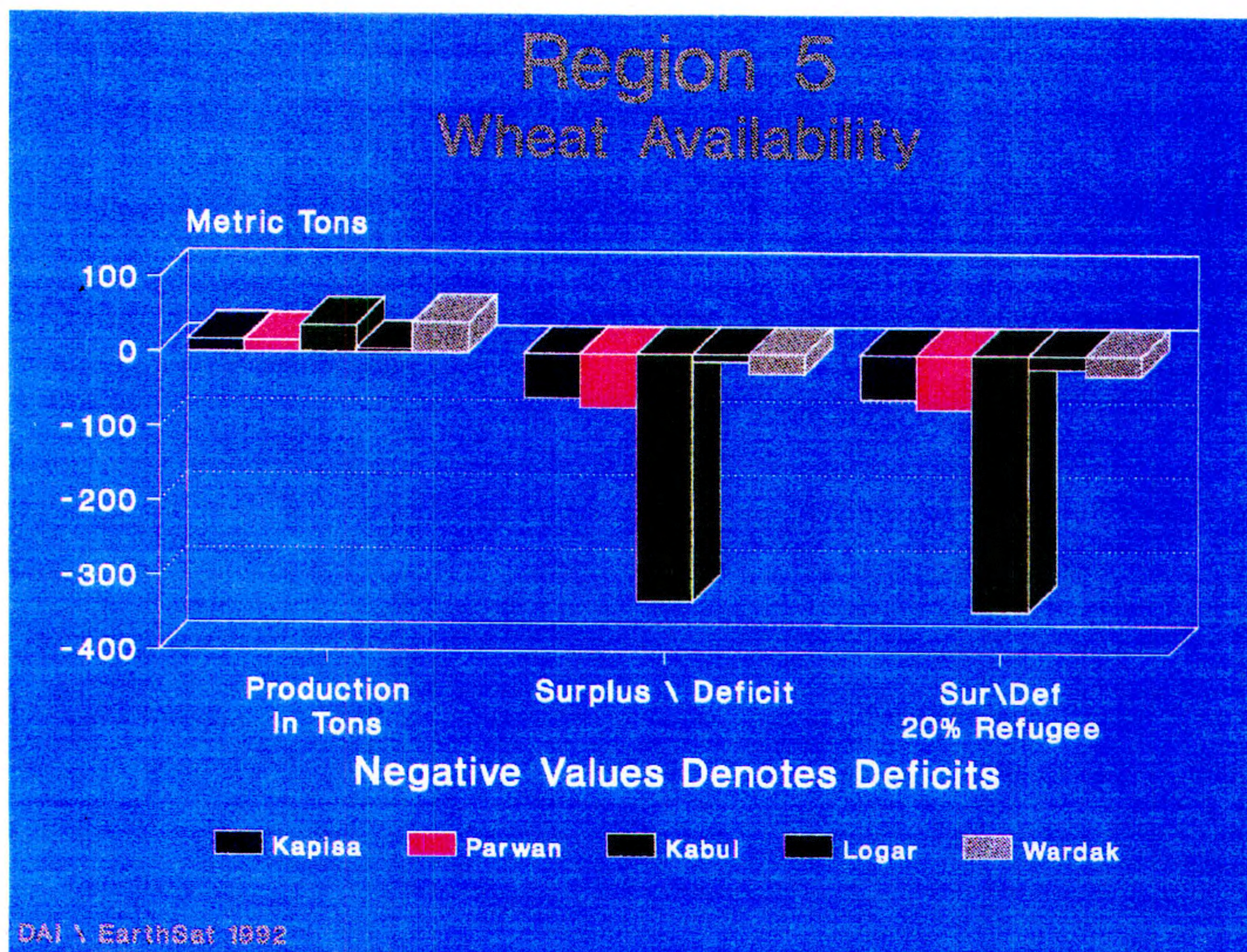
Region 4: Ghor, Bamyan



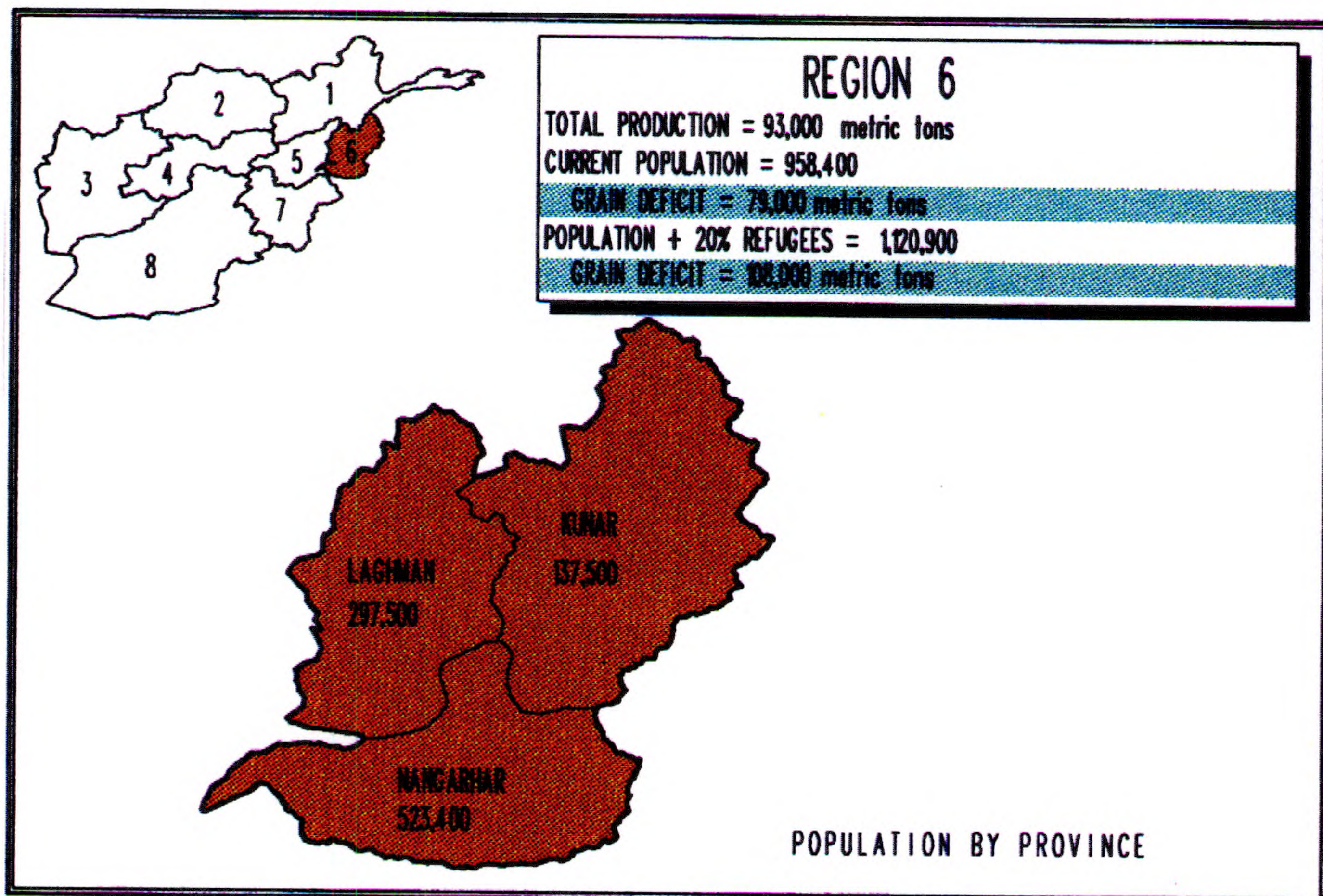


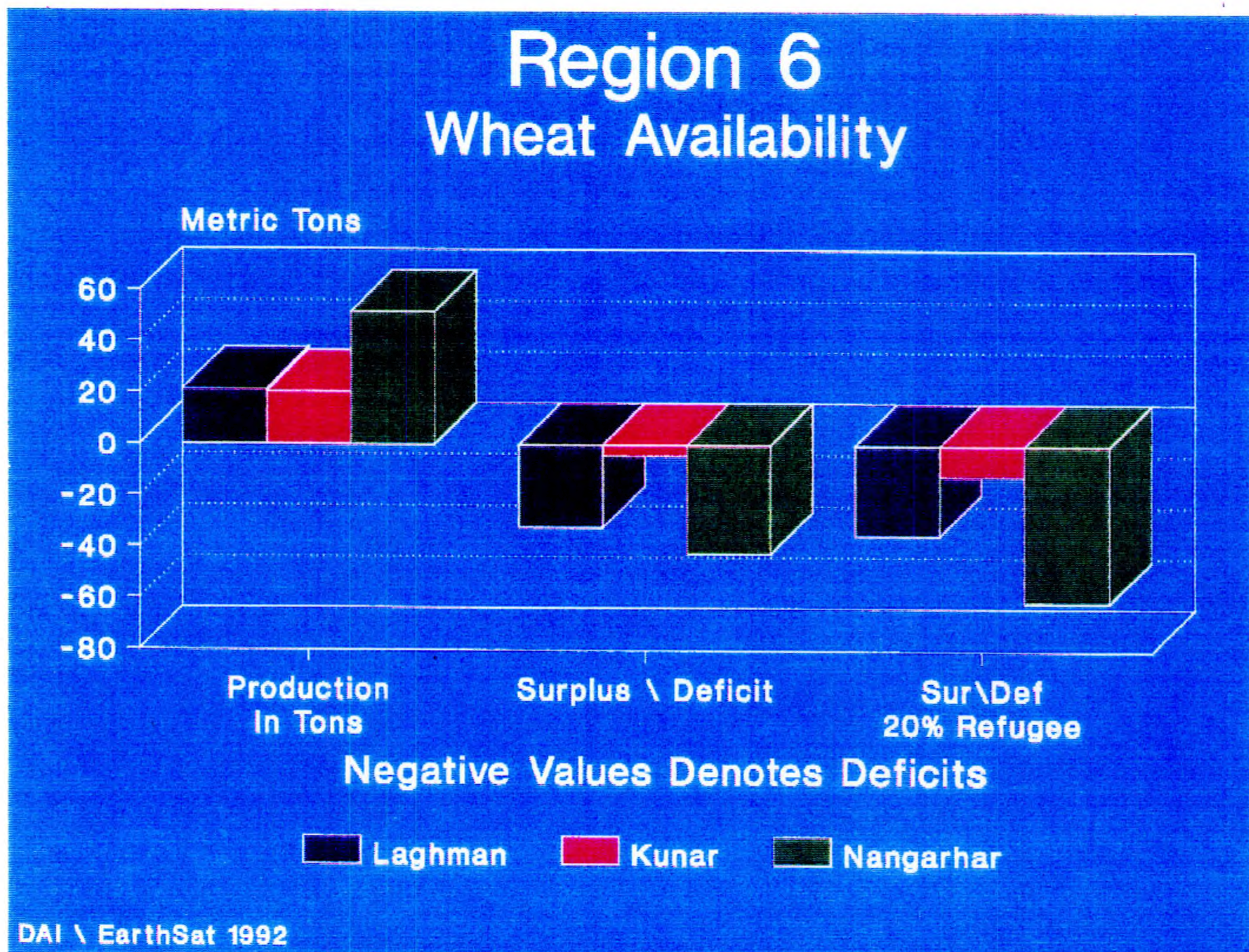
Region 5: Parwan, Logar, Wardak, Kapisa, Kabul



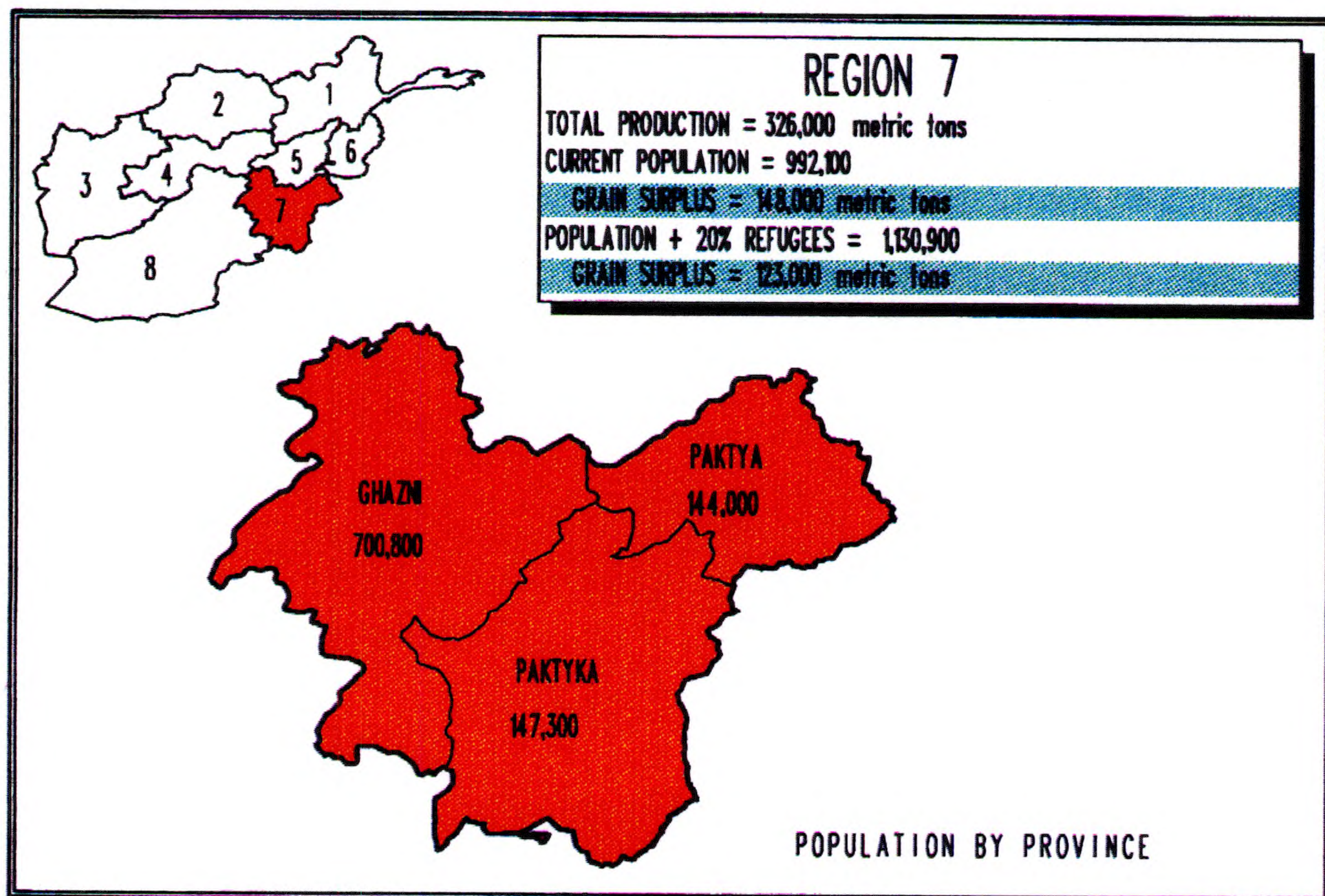


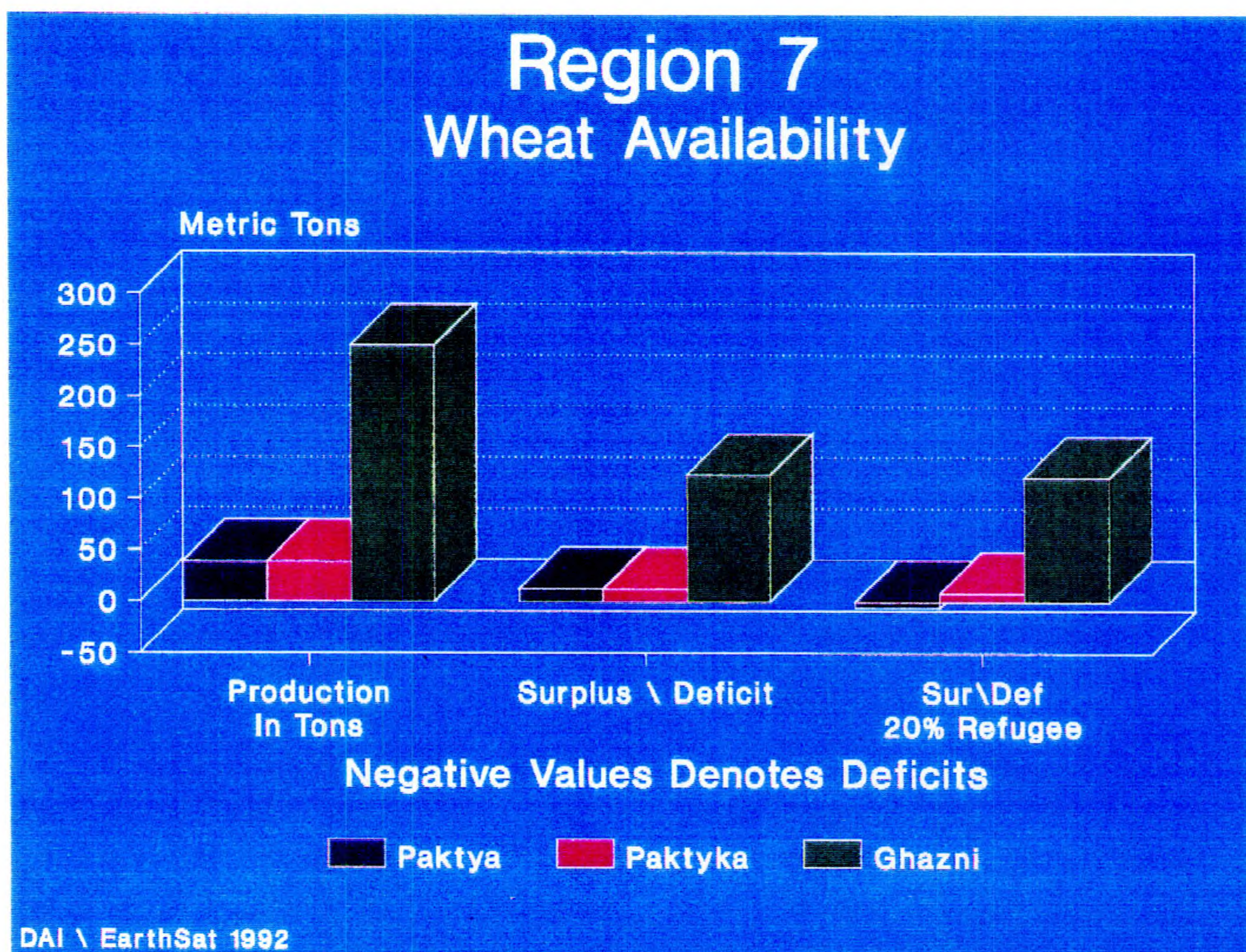
Region 6: Nangarhar, Kunar, Laghman





Region 7: Paktyka, Ghazni, Paktya





SUMMARY

Development Alternatives, Inc. (DAI) and the Earth Satellite Corporation (EarthSat) have developed a computerized model to estimate grain production throughout Afghanistan. The model uses historical data on agricultural production, satellite imagery, meteorological data, survey data collected by field staff of DAI's Private Sector Agribusiness component of the Afghanistan Agricultural Support Project (ASSP/PSA) and agencies of the United Nations working in Afghanistan.

For the purposes of this report, a DAI/EarthSat team used the model to forecast the total production of Afghanistan's 1991/92 winter wheat crop. The model uses population estimates and minimum per capita wheat consumption requirements to estimate the capacity of the 1991/92 winter wheat crop to feed Afghanistan's population. The data indicate that wheat production will be **insufficient** to meet the basic consumption requirements of the estimated population in 13 provinces of the country (51 percent of the population of Afghanistan): Badakhshan, Bamyan, Kabul, Kapisa, Kunar, Laghman, Logar, Ningarhar, Oruzgan, Paktya, Parwan, Samangan and Wardak. Wheat production in the remaining 16 provinces of the country will be sufficient to meet the consumption requirements of the populations estimated to currently reside in these provinces.

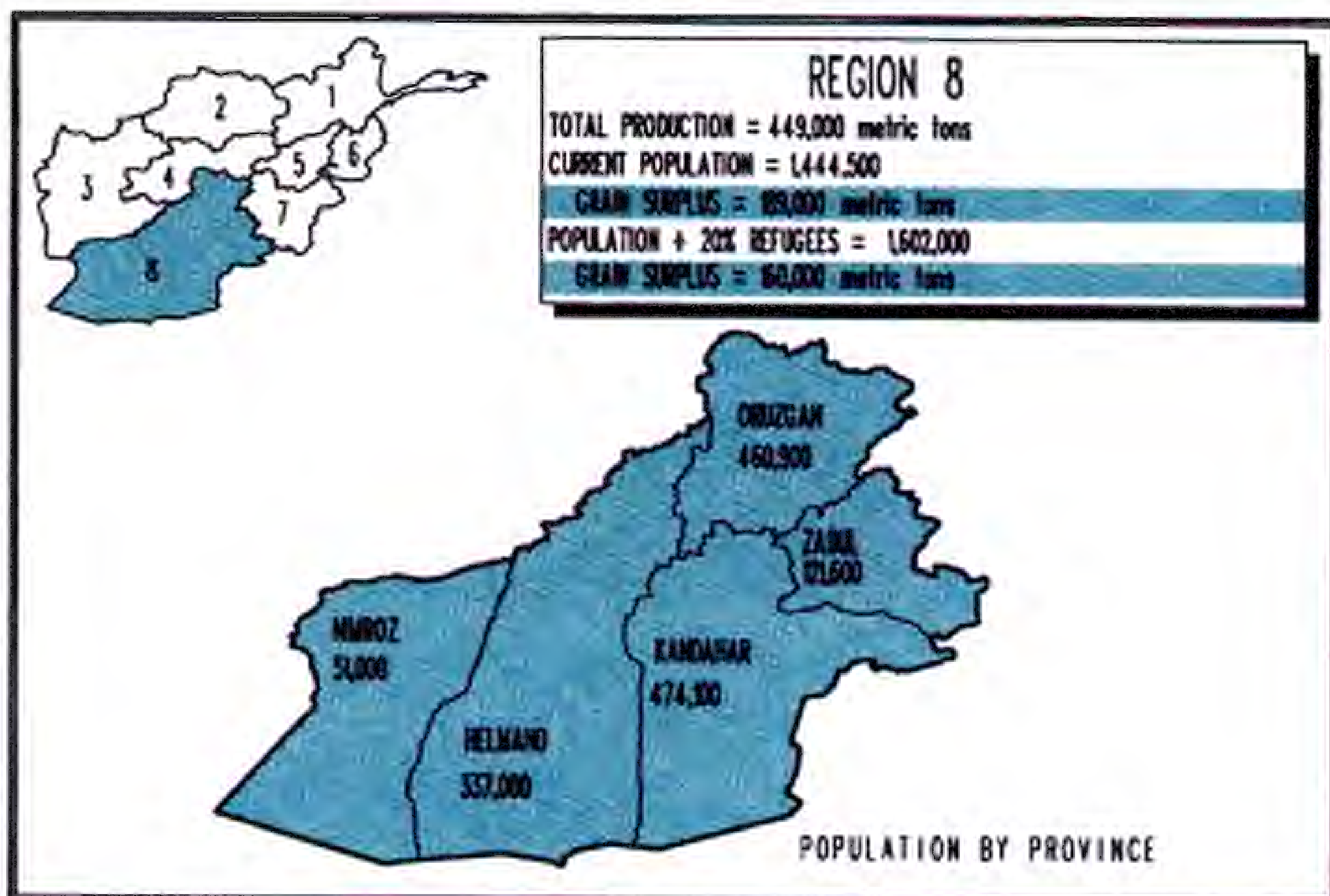
Large numbers of Afghans are settled as refugees in Pakistan. The DAI/EarthSat analyzed the impact of repatriation of 20 percent of refugees on the estimated 1991/92 wheat supply. The results of this analysis indicate that the wheat production shortfalls predicted for the 13 provinces listed above would be intensified, but that production in the remaining provinces would remain sufficient to meet the needs of a population increased by 20 percent.

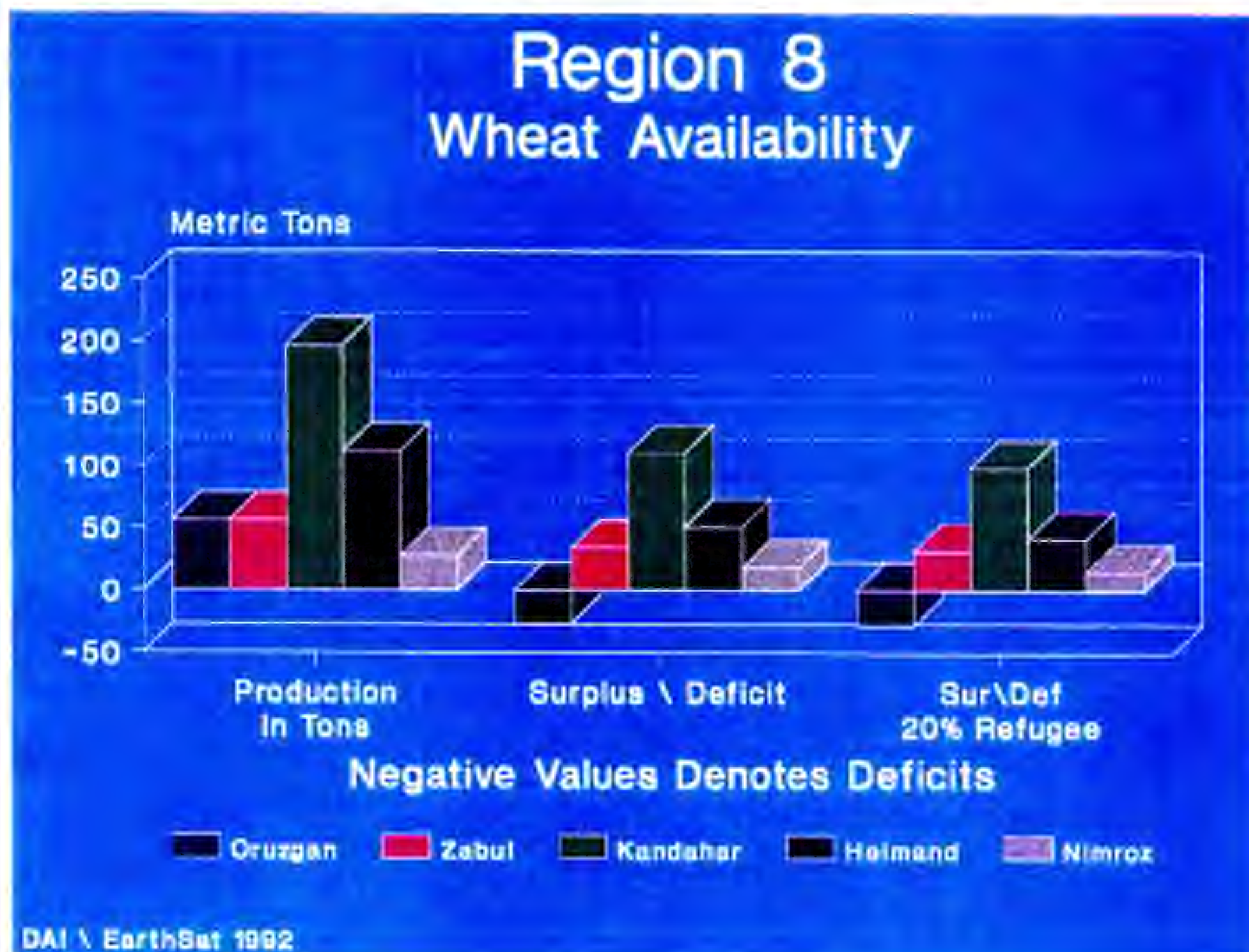
A more accurate assessment of the potential for Afghanistan's 1991/92 wheat production to meet population food needs will require additional data. The accuracy of the wheat production estimates can be refined with additional data on **yield reduction factors** (disease, flooding, pest damage, civil unrest preventing planting or harvesting); **post-harvest loss** (grain spoilage, pest damage); and data to enable satellite interpretation of differentiations of poppy from wheat crops. The capacity of wheat supply to meet the demands of areas currently showing shortfalls will require up-dated information on transport and trade conditions.

SECTION 1: INTRODUCTION

The Private Sector Agribusiness component of the Afghanistan Agricultural Sector Support Project (ASSP/PSA) is a development assistance program implemented by Development Alternatives, Inc. and funded by the Office of the United States Agency for International Development's Representative for Afghanistan (O/AID/REP). ASSP/PSA focuses it efforts in two areas of Afghanistan's agricultural development: technical training for Afghan farmers to increase food production and the management of information on agricultural production and markets in Afghanistan.

Region 8: Zabul, Kandahar, Helmand, Nimroz, Oruzgan





APPENDIX II

The maps and charts presented in this appendix depict the surplus and deficit grain conditions in each of the eight regions if 20% of the Afghan refugees in Pakistan were to return to their home provinces. For each region and provinces encompassed in each region, the tables show (in the following order):

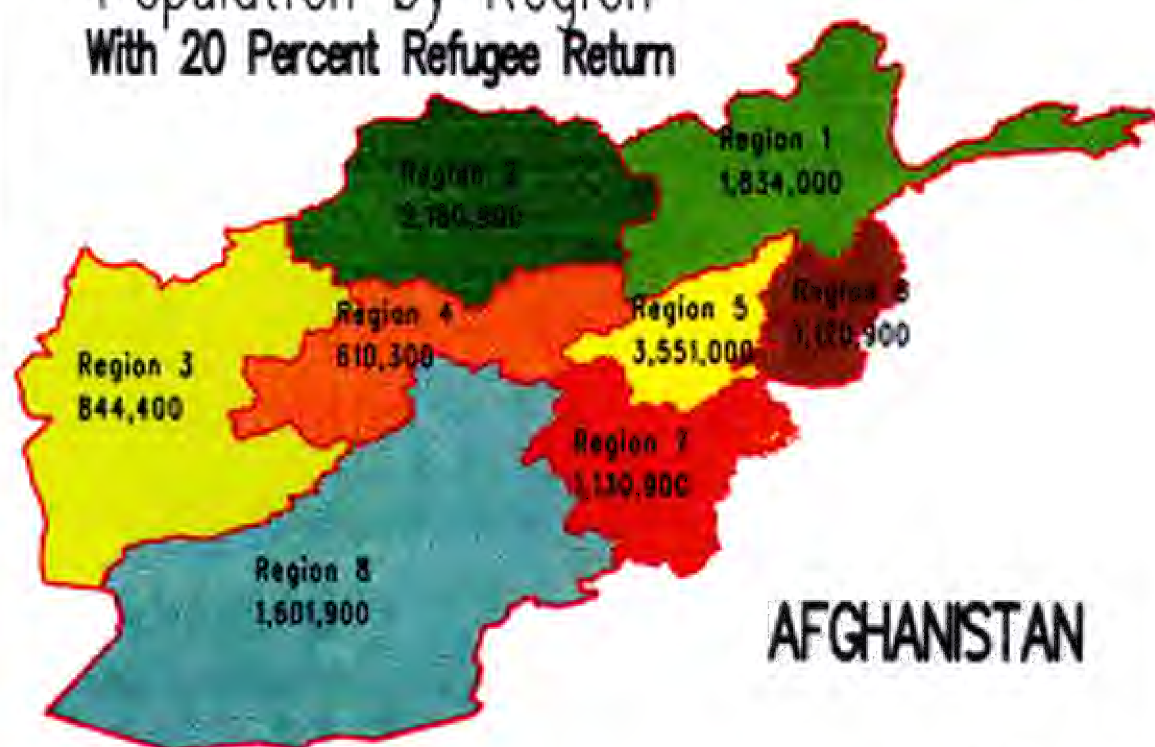
- ❑ estimates of population increased by 20 percent refugee repatriation;
- ❑ wheat surpluses and deficits based on yield/persons/15 kgs per month with 20 percent refugee repatriation.

Appendix 2: Population with Refugee Return

PROVINCE	POPULATION WITH REFUGEE RETURN	PRODUCTION METRIC TONS	WHEAT SURPLUS/DEFICIT
REGION 1			
KUNDUZ	426,616	192,747	115,955
TAKHAR	542,941	146,572	48,842
BAGHLAN	310,306	89,547	33,691
BADAKHSHAN	554,122	24,820	-74,921
TOTAL	**1,833,985**	**453,686**	**123,568**
REGION 2			
JAWZJAN	622,027	204,345	92,380
BALKH	594,378	163,071	56,082
FARYAB	667,578	177,867	57,702
SAMANGAN	296,879	34,335	-19,103
TOTAL	**2,180,862**	**579,618**	**187,062**
REGION 3			
FARAH	180,341	86,040	53,578
HERAT	480,227	187,770	101,329
BADGHIS	183,846	175,312	142,219
TOTAL	**844,414**	**449,122**	**297,129**
REGION 4			
GHOR	305,673	125,149	70,127
BAMYAN	304,652	21,755	-33,082
TOTAL	**610,325**	**146,904**	**37,045**
REGION 5			
PARWAN	497,135	15,912	-73,572
LOGAR	128,448	5,248	-17,872
WARDAK	377,544	40,833	-27,125
KAPISA	425,161	16,946	-59,583
KABUL	2,122,798	36,631	-345,472
TOTAL	**3,551,086**	**115,570**	**-523,625**

Appendix 2: Population with Refugee Return (continued)

PROVINCE	POPULATION WITH REFUGEE RETURN	PRODUCTION METRIC TONS	WHEAT SURPLUS/DEFICIT
REGION 6			
NANGARHAR	627,389	51,633	-61,297
KUNAR	179,660	20,420	-11,918
LAGHMAN	313,821	21,203	-35,284
TOTAL	**1,120,870**	**93,256**	**-108,500**
REGION 7			
PAKTYKA	169,368	38,376	7,889
GHAZNI	714,771	249,735	121,076
PAKTYA	246,753	38,376	-6,039
TOTAL	**1,130,892**	**326,487**	**122,926**
REGION 8			
ZABUL	134,467	56,099	31,894
KANDAHAR	539,978	196,395	99,198
HELMAND	389,669	111,920	41,779
NIMROZ	68,736	27,676	15,303
ORUZGAN	469,103	56,434	-28,004
TOTAL	1,601,953	446,524	160,172
COUNTRY TOTALS	**12,874,387**	**2,613,167**	**295,775**





Appendix II: Population with Refugee Return

On-going hostilities within Afghanistan have created obstacles to the traditional system of delivering technical assistance and agricultural inputs to potential beneficiaries in the country. These obstacles, combined with inability to gather field data in Afghanistan on a consistent basis, have prompted ASSP/PSA to develop a modeling approach, assisted by remotely sensed data, to understand the existing food production situation in Afghanistan. O/AID/REP, through the ASSP/PSA, contracted with the Earth Satellite Corporation (EarthSat) to begin a grain production/availability modeling process with the initiation of an CROPCAST® exercise in March 1990.[1] A DAI/Earthsat team augmented the CROPCAST analysis to include current populations in Afghanistan, potential refugee repatriation, and transport infrastructure information. The addition of these data sets enabled the team to estimate the magnitude and location of surplus or deficit wheat production in Afghanistan for 1992, as well as the potential for timely transport of surplus wheat to deficit areas.

This report presents the results of the Afghanistan Wheat Availability Study. The report contains:

- a discussion of methodology;
- maps and tables illustrating population distribution and wheat production levels at the national, regional and provincial levels;
- a discussion of the surplus and deficit wheat production conditions; and
- recommendations for additional research to improve the accuracy of the study.

The DAI/EarthSat team carried out organized and analyzed the data that support this study through the use of the ASSP/PSA Geographic Information System for Afghanistan (GIS). This report demonstrates the capacity of GIS as a planning tool. As additional and better quality data become available, the DAI/EarthSat team will have the ability to update this and related reports on a regular basis.

SECTION 2: METHODOLOGY

Over the past eighteen months, a DAI/EarthSat team constructed a computerized model to estimate grain production throughout Afghanistan. The model uses historical data on agricultural production, satellite imagery, meteorological data, ground truth data, and

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[1] EarthSat CROPCAST grain yield estimates are calibrated using a regression approach based on climate parameters (rainfall, temperatures) derived from satellites. Precipitation analysis used NOAA weather satellite data and data from weather stations in Afghanistan (where available). The 1991 Afghanistan wheat yield estimate (May 1991) was updated in the fall of 1991 to incorporate meteorological data collected during the interim period. Higher than normal precipitation was observed throughout Afghanistan.


AFGHANISTAN
Regionalization
BADAKHSHAN
KONDUZ
AKHAR
1
JAWZJAN
BALKH
2
FARYAB
SAMANGAN
BAGHLAN
KAPISA
KONAR
BADGHIS
BAMYAN
PARWAN
AGHMAN
6
5
KABUL
WARDAK
HERAT
GHOR
4
LOGAR
3
PAKTYA
ORUZGAN
GHAZNI
FARAH
7
ZABUL
PAKTYKA
NIMROZ
8
KANDAHAR
HELMAND
C.I.S.
IRAN
AFGHANISTAN
PAKISTAN

Figure 1

information from surveys conducted by field staff of ASSP/PSA and agencies of the United Nations working in Afghanistan.

For the purpose of this study, the DAI/EarthSat team organized the data on a regional, as well as provincial, basis. The team grouped the 29 provinces of Afghanistan into eight regions to enable assistance and development planners to better determine and target inputs (Figure 1). The principal criteria for this regionalization are similarities in agricultural production factors (climate, topography, soils, crops and cropping patterns) and logistical considerations (transport networks linking provinces within a region).

To estimate basic food availability in Afghanistan in the coming year, the DAI/EarthSat team constructed a model based on the following four data sets:

- estimated wheat production by province and region;
- current population estimates by province and region;
- a minimum per capita requirement of wheat; and
- estimated potential for transporting wheat between provinces and regions.

In addition, because large numbers of Afghans are settled as refugees in Pakistan, the DAI/EarthSat team analyzed the impact of potential refugee repatriation on Afghanistan's wheat supply. To carry out this analysis, the team used current population estimates of Afghan refugees settled in Pakistan and data on their provinces of origin. These data sets are discussed below.

Estimated Wheat Production: Key Assumptions

The DAI/EarthSat team combined CROPCAST data through May 1991 with updated (to October 1991) meteorological data to predict the total amount of wheat that will be produced in each province of Afghanistan during the 1991/92 cropping season. In addition, the team conducted a wheat quality analysis based on soil moisture conditions to adjust wheat production estimates for each province. The team then used the ASSP/PSA Geographic Information System (GIS) software to produce a data layer[2] of wheat **availability** estimates by province for the entire country in 1992 (see Table 1).

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[2] GIS technology allows sets of geographically referenced data (such as political boundaries, settlements, agricultural zones, communications networks) to be stored in separate computerized "layers". These layers can be combined to examine statistical relationships between data. The GIS software can render these statistical relationships into numerical format, as graphs or as visual interpretations of relationships in the form of maps. Combinations of data layers are called "composite overlays." In this study, for example, the DAI/EarthSat team overlaid (or superimposed) population layers on wheat yield estimates to determine the relationship between wheat production and population.

In calculating these wheat availability estimates by province, the DAI/EarthSat team made a number of **key assumptions** with operational definitions:

- All cropland identified in the satellite imagery used to prepare this study is planted with wheat. Without ground truth data, distinctions of wheat from barley or poppy crops are not apparent using remotely sensed data.[3]
- Twenty percent of the potential wheat crop is lost either in the field (e.g., to disease, pests, flooding, or civil unrest preventing sowing or harvesting) or in storage (e.g., pest damage or spoilage);[4]
- Fifteen percent of all wheat produced is retained as seed for the next wheat cropping cycle;[5]
- No wheat reserves remain from the 1990/91 cropping season in Afghanistan; and
- No imports of wheat to Afghanistan have occurred during the 1991/92 season.

Because of the lack of data, the model cannot account for distribution bottlenecks within a province caused by damage to transport infrastructure, political and ethnic cleavages, or armed conflict. Thus, the model assumes an equitable distribution of wheat over an entire population of a province. This issue is discussed in more detail below within the context of transport.

Population Estimates

The United Nations High Commission for Refugees (UNHCR) and the O/AID/REP provided the estimates used in this study for the current population of Afghanistan and for refugee population settled in Pakistan.[6] The accuracy of these population estimates

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[3] Both barley and poppy compete with the winter wheat crop in Afghanistan. Barley, grown largely as a fodder crop, traditionally accounts for between 5 to 10 per cent of the winter grain crop. The cultivation of poppy, traditionally confined to parts of Badahkshan, Ningarhar and the Helmand-Arghandab Valley, has increased during the course of the war. The implications of this expansion on the evaluation of the 1991/92 wheat production estimates is discussed below.

[4] Data provided by the field staff of the ASSP/PSA Agricultural Development and Training (ADT) component.

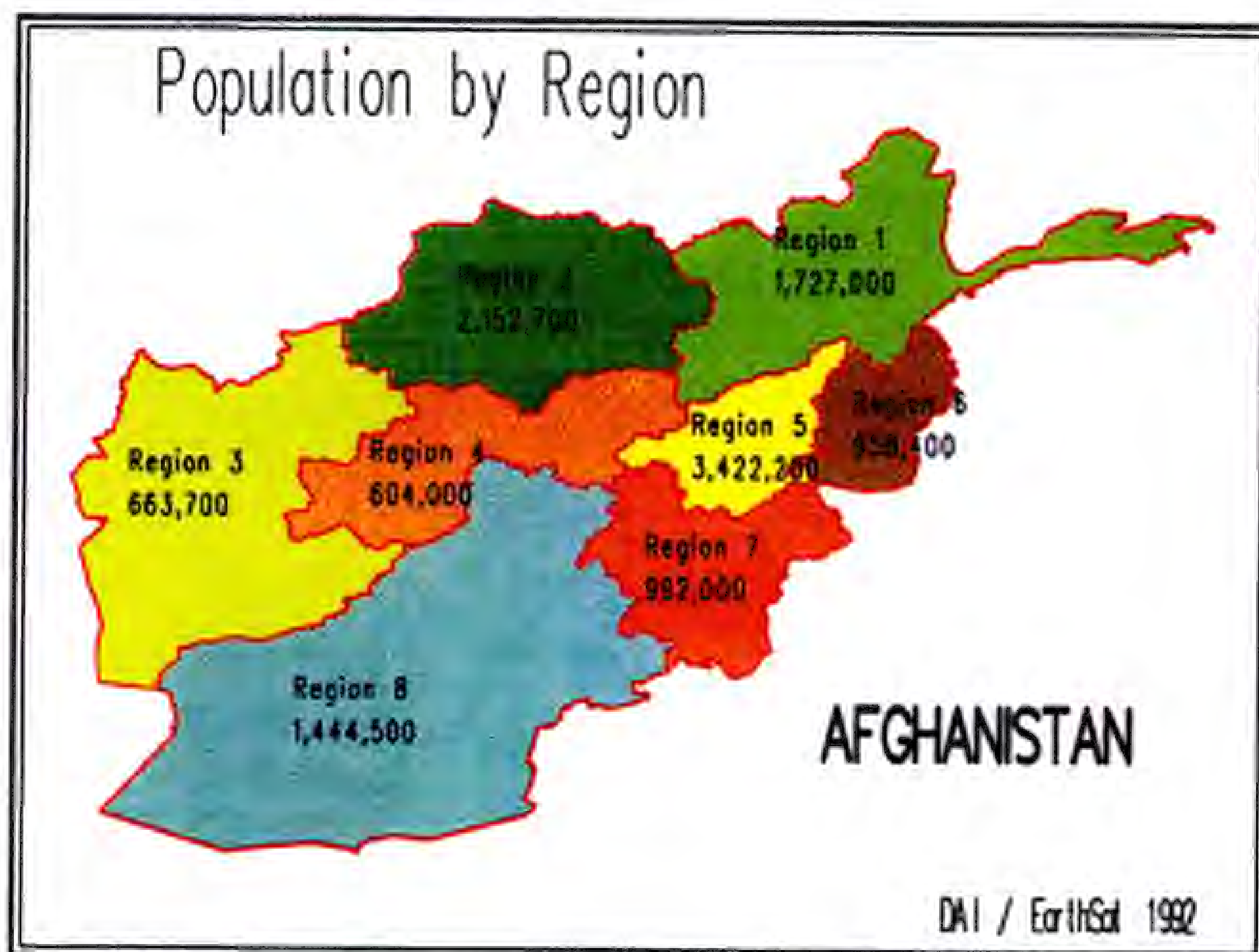
[5] Data provided by ADT field staff.

Table 1: Current Population

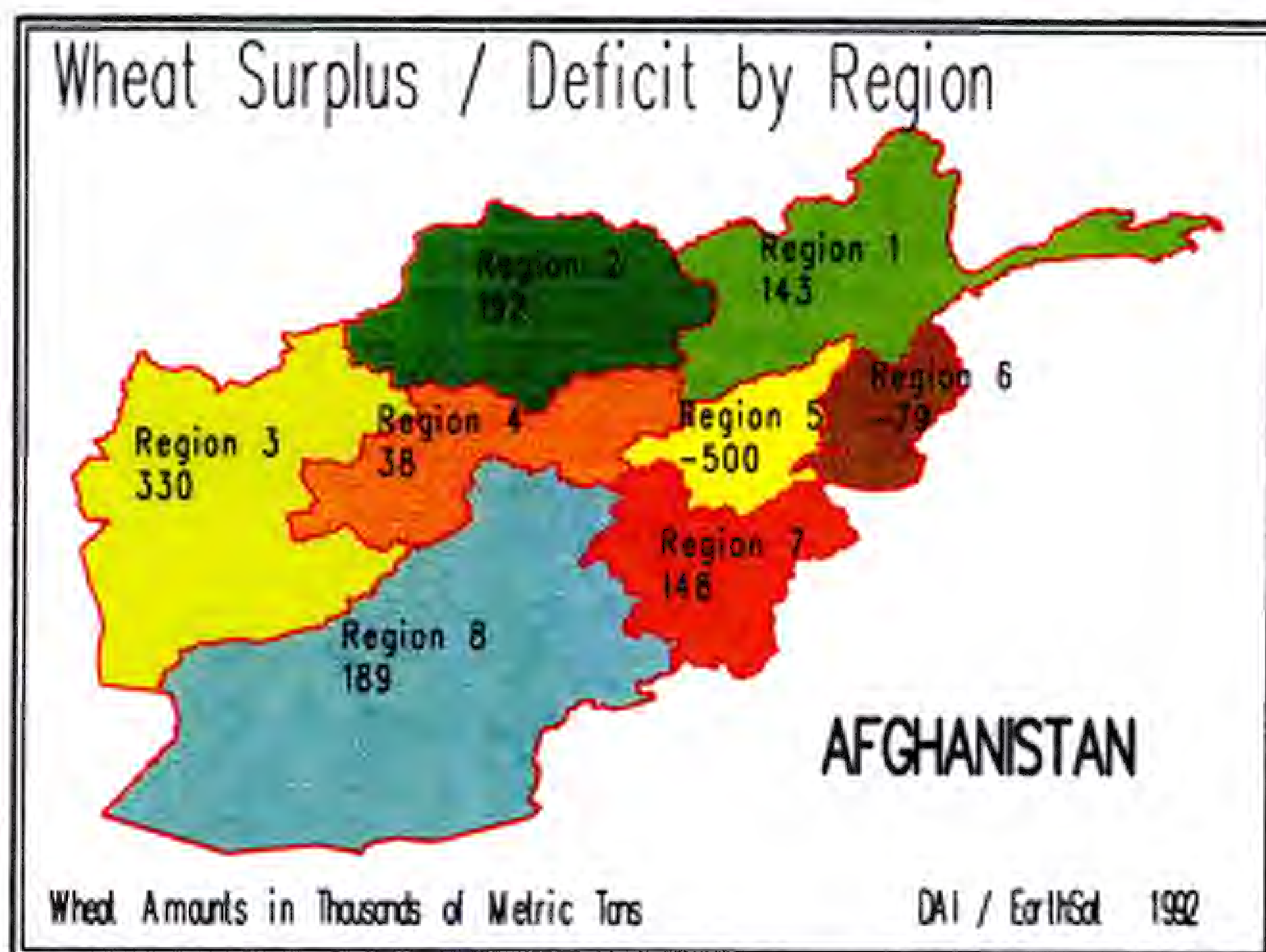
PROVINCE	CURRENT POPULATION	PRODUCTION METRIC TONS	WHEAT SURPLUS/DEFICIT
REGION 1			
KUNDUZ	367,892	192,747	126,527
TAKHAR	539,294	146,572	49,500
BAGHLAN	265,754	89,547	41,712
BADAKHSHAN	554,059	24,820	-74,910
TOTAL	**1,726,999**	**453,686**	**142,829**
REGION 2			
JAWZJAN	608,063	204,345	94,894
BALKH	585,667	163,071	57,651
FARYAB	665,973	177,867	57,992
SAMANGAN	292,968	34,335	-18,399
TOTAL	**2,152,671**	**579,618**	**192,138**
REGION 3			
FARAH	130,608	86,040	62,531
HERAT	382,683	187,770	118,888
BADGHIS	150,426	175,312	148,236
TOTAL	**663,717**	**449,122**	**329,655**
REGION 4			
GHOR	302,497	125,149	70,700
BAMYAN	301,530	21,755	-32,520
TOTAL	**604,027**	**146,904**	**38,180**
REGION 5			
PARWAN	488,749	15,912	-72,062
LOGAR	85,301	5,248	-10,106
WARDAK	372,203	40,833	-26,163
KAPISA	423,161	16,946	-59,222
KABUL	2,052,782	36,631	-332,869
TOTAL	**3,422,196**	**115,570**	**-500,422**

Table 1: Current Population (continued)

PROVINCE	CURRENT POPULATION	PRODUCTION METRIC TONS	WHEAT SURPLUS/DEFICIT
REGION 6			
NANGARHAR	523,398	51,633	-42,578
KUNAR	137,461	20,420	-4,322
LAGHMAN	297,510	21,203	-32,348
TOTAL	**958,369**	**93,256**	**-79,248**
REGION 7			
PAKTYKA	147,329	38,376	11,857
GHAZNI	700,793	249,735	123,593
PAKTYA	143,973	38,376	12,461
TOTAL	**992,095**	**326,487**	**147,911**
REGION 8			
ZABUL	121,556	56,099	34,219
KANDAHAR	474,051	196,395	111,066
HELMAND	337,001	111,920	51,260
NIMROZ	50,928	27,676	18,509
ORUZGAN	460,931	56,434	-26,533
TOTAL	1,444,467	448,524	188,521
COUNTRY TOTALS	**11,964,541**	**2,613,167**	**459,564**



Population by Region
Region 1
1,727,000
Region 2
2,152,700
Region 3
663,700
Region 4
604,000
Region 5
3,422,200
Region 6
Region 7
997,000
Region 8
1,444,500
AFGHANISTAN
DAI / EarthSat 1992



Wheat Surplus / Deficit by Region
Region 1
143
Region 2
192
Region 3
330
Region 4
38
Region 5
-500
Region 6
-79
Region 7
146
Region 8
189
AFGHANISTAN
Wheat Amounts in Thousands of Metric Tons
DAI / EarthSat 1992

Figure 2

remains problematic. However, these estimates are valuable for showing the relative size of populations between provinces or regions. The DAI/EarthSat team entered these estimates into the GIS data base to create a data layer and map of the population by province in Afghanistan. These data were superimposed on the wheat production data layer to match wheat supply with population on a provincial basis.

Minimum Wheat Requirement

To determine the capacity of the wheat supply to feed the Afghan population, the DAI/EarthSat team divided wheat production statistics by a standard consumption rate of 15 kgs of wheat per person/per month. This rate of consumption is commonly accepted in the Afghan and international relief assistance community as a minimum nutritional requirement. The figure is an average, and it weighs differential rates of consumption by age, gender, and caloric expenditure.

The modeling process identifies provinces and regions in Afghanistan where wheat production is insufficient to meet the minimum consumption requirements of the population (referred to herein as wheat production **deficit** areas) and provinces where wheat production is sufficient to meet the minimum consumption requirements of the population (referred to herein as wheat production **surplus** areas). The results of this modeling process are presented in Table 1 and Figure 2. The DAI/EarthSat team analyzed these results to determine the magnitude of wheat surpluses and deficits within regions and provinces, and to determine the potential for grain surpluses to feed populations in deficit areas.

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6 *The Afghan Population Inside and Out*. Office of the A.I.D. Representative for Afghanistan, 1990; *Report on Afghan Refugee Origins*, UNHCR, 1990.

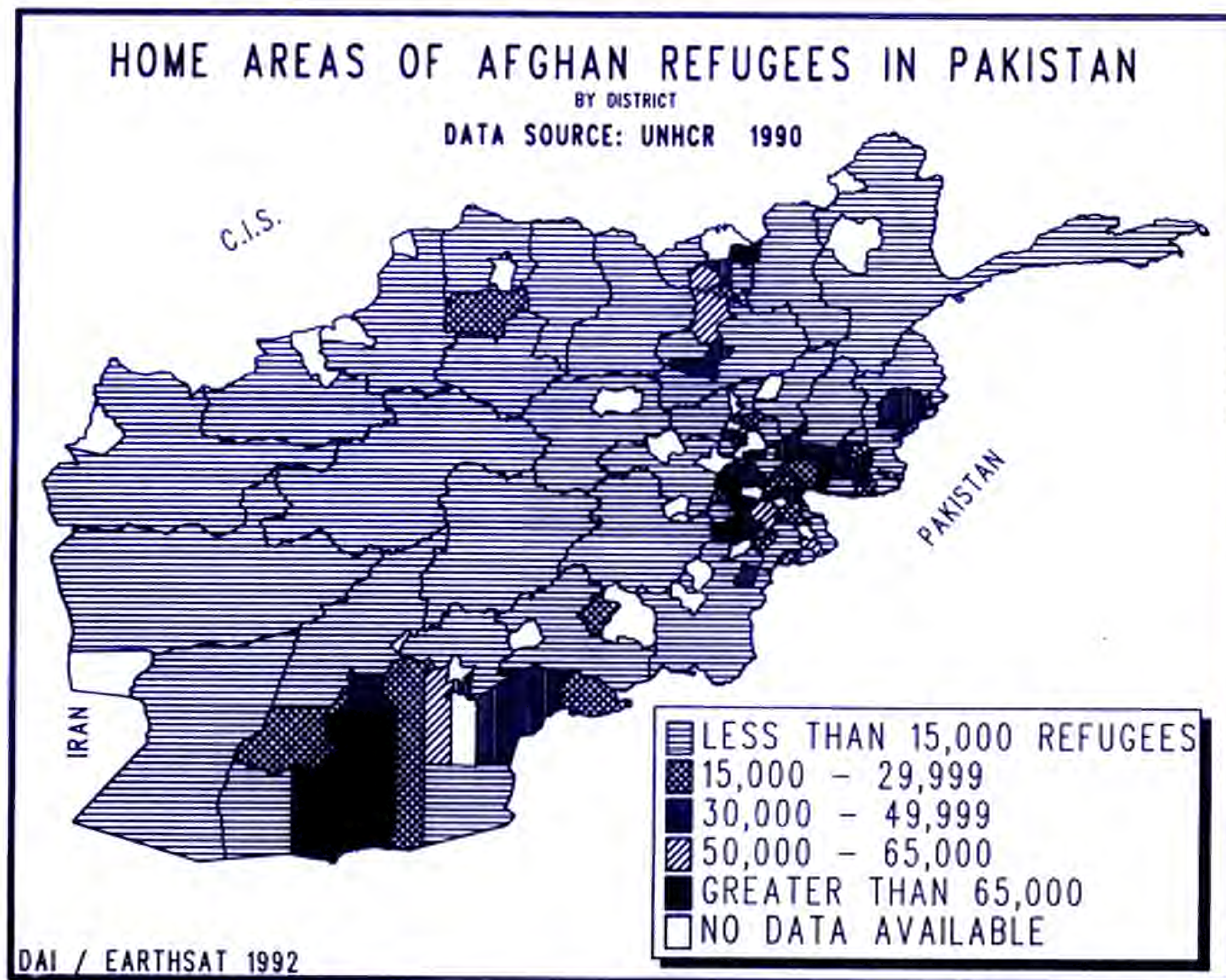

HOME AREAS OF AFGHAN REFUGEES IN PAKISTAN
BY DISTRICT
DATA SOURCE: UNHCR 1990
C.I.S.
PAKISTAN
IRAN
LESS THAN 15,000 REFUGEES
15,000 - 29,999
30,000 - 49,999
50,000 - 65,000
GREATER THAN 65,000
NO DATA AVAILABLE
DAI / EARTHSAT 1992

Figure 3

Transport Potential

The DAI/EarthSat team examined several sources of information on the conditions of transport infrastructure (e. g., roads, bridges) in Afghanistan. These include four field survey reports conducted by ASSP/PSA, UNHCR provincial profiles, and a road reconnaissance undertaken by the Afghan Society of Engineers and Architects.[7] The team also considered some recent anecdotal evidence on road conditions. Nearly all of the available information on transport conditions pertains to the southern and eastern provinces of Afghanistan, corresponding to the original target areas of the ASSP/PSA. However, much of this information is outdated and problems recorded by earlier surveyors may no longer exist (e.g., conditions of bridges, prevalence of land mines). Thus, the findings presented in this report represent only a preliminary evaluation of the potential for regions with surplus wheat production to supply wheat to regions with wheat deficits. These findings are discussed in Section 3.

Impact of Refugee Repatriation

According to the UNHCR, more than two million refugees from Afghanistan are reported to be settled in the western provinces of Pakistan. At least another one million Afghan refugees are reported to be settled in Iran. Hundreds of thousands of Afghans have been displaced from rural villages to other areas of Afghanistan, particularly urban areas. The resolution of the Afghan conflict and the return of refugees and the internally displaced will have enormous implications on food availability and distribution throughout Afghanistan. Moreover, a majority of the Afghan refugees in Pakistan come from a few of the eastern and southern provinces (Figure 3). Consequently, the return of even 20 percent of refugees to these provinces will have a significant impact on grain availability.

While the timing of refugee return is impossible to predict, the DAI/EarthSat team analyzed the impact of a nominal repatriation (20 percent) of Afghan refugees to their provinces of origin on provincial wheat supplies. The results of this analysis are presented in Appendix II.

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[7] *Report on Findings of Bazaar Survey I*, DAI/ASSP, April 1990; *Report on Findings of Bazaar Survey II*, DAI/ASSP, May 1990; *Survey III: A Preliminary Analysis of Border Catchment Points*, DAI/ASSP, August 1990; *Report of Findings of Bazaar Survey IV*, DAI/ASSP, October 1990; *Background Report (Kandahar*, Kunar, Ningarhar, Paktia, Paktika), UNHCR, September 1989; *Background Report (Logar)*, UNHCR, December 1989; Afghan Society of Engineers and Architects, *Preliminary Site Reconnaissance: Design and Cost Estimates for Four Direct Access Routes from Pakistan to Western Afghanistan*, 1990.

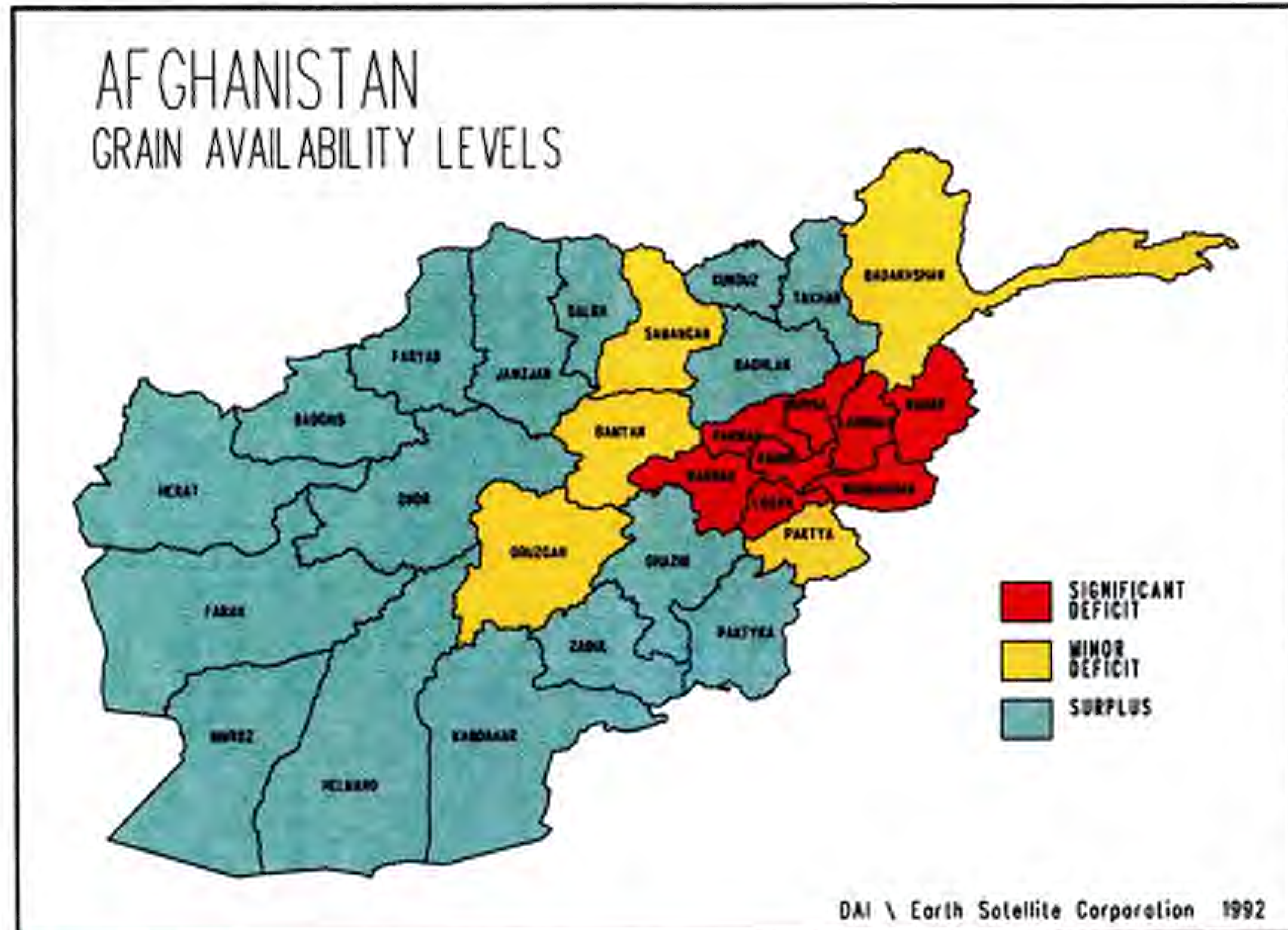

AFGHANISTAN
GRAIN AVAILABILITY LEVELS
BADAKHSHAN
SAMANGAN
BAGHLAN
JAWZJAN
BAMYAN
BADGHIS
HERAT
FARAH
PAKTYA
PAKTIKA
ZABUL
KANDAHAR
SIGNIFICANT DEFICIT
MINOR DEFICIT
SURPLUS
DAI \ Earth Satellite Corporation 1992

Figure 4

SECTION 3: SURPLUS AND DEFICIT PRODUCTION CONDITIONS

Wheat has traditionally been the single most important food crop cultivated in Afghanistan. Because less than a quarter of Afghanistan's land surface is arable, at least 75 percent of the country's wheat production is confined to irrigated lowlands, mainly the upper and lower valleys of the Kabul River and its tributaries and the Helmand-Arghandab river valleys. Another one quarter of Afghanistan's wheat crop is rain-fed, mainly in the northern plains.

As a result of this pattern of agricultural production, populations in many areas of Afghanistan have long depended on the surplus regions for food supply. Indeed, many of the provinces identified in this report as "wheat deficit" have never been self-sufficient in wheat production. Their populations have, instead, relied on enduring patterns of trade with neighboring provinces and countries to obtain sufficient stocks of wheat.

Taking all of the above factors, as well as current transport, economic and political conditions, into consideration, the DAI/EarthSat team identified three levels of wheat availability in Afghanistan in 1992 (Figure 4):

- ❑ **significant deficit areas:** provinces/regions where demand outstrips supply, and the capacity of neighboring provinces to meet demand is improbable;
- ❑ **minor deficit areas:** provinces/regions where demand outstrips supply, and the capacity of neighboring provinces to meet demand is probable; and
- ❑ **surplus areas:** provinces/regions where supply appears sufficient to meet demand.

Surplus and deficit statistics are presented in Appendix II.

According to the data illustrated above, Regions 5 and 6 are likely to experience a **significant deficit** of winter wheat in 1992. In other words, each of the provinces in these regions will produce insufficient wheat to meet the needs of even its current population.

One province in each of regions 1, 2, 4 and 8 is likely to experience a **limited deficit** of winter wheat in 1992. Badakhshan (Region 1), Samangan (Region 2), Bamyan (Region 4) and Oruzgan (Region 8) will not produce enough wheat to meet the demands of current populations, but neighboring provinces in each region are expected to produce wheat surpluses that will be sufficient to offset those deficits. Again, this model assumes that enduring patterns of trade among these provinces are still intact. A 20 percent refugee return will increase wheat deficits in the four provinces cited above and will reduce the surpluses of wheat available for export in neighboring provinces.

Paktya province (Region 7) is expected to produce more wheat than is required by its current population. However, a return of 20 percent of the Afghan refugees who originated in Paktya province will reduce wheat availability to a level below self- sufficiency and will move the province to the limited deficit area category.

All three provinces in Region 3 (Helmand, Farah and Badghis) are expected to produce sufficient wheat for current populations. Wheat production will also be sufficient to absorb a repatriation of well over 20 percent of the refugees originating from these provinces who settled in Pakistan. The vast majority of refugees from these provinces, however, are settled in Iran. Thus, an accurate assessment of the impact of refugee return to these provinces will require additional data.

In most cases, the deficit and surplus areas identified by this study are consistent with traditional grain production patterns. However, the events of more than a decade of war undoubtedly have negatively affected wheat production in some regions. Political unrest and armed conflict in Region 6, for example, continues while in Region 5, the influx of internally displaced persons has greatly increased the population in, and around, the Kabul city area. The deficits indicated by the data in Samangan, Laghman, Logar are less easily explained. With their relatively low populations and traditional ability to produce ample wheat supplies, one would expect higher yields or, at least, self-sufficiency. This discrepancy between current production estimates and historical evidence underscores the need for field data to account for the circumstances in specific areas.

In summation, this study suggests that:

- ❑ Additional wheat supplies required in the provinces identified as minor deficit areas (Badakhshan, Samangan, Bamyan, Oruzgan and Paktya) can be offset by surplus wheat production anticipated in neighboring provinces.

- ❑ Anticipated grain surpluses calculated for the entire country appear adequate to meet production shortfalls predicted in the major deficit areas (Regions 5 & 6), at least through 20 percent refugee return.

These findings not withstanding, several factors impede current development of a fully accurate forecast of wheat availability in Afghanistan in 1992. First, the lack of information on amount of land under wheat cultivation, the farmers' ability to plant or harvest that land, and the inability to distinguish wheat from poppy in the remotely sensed data have undoubtedly affected the wheat production estimates used in this study.

Second, we cannot assume that wheat surpluses will actually be available to the deficit areas. For example, several factors may mediate against the free movement of supply to meet demand in the significant grain deficit regions. At present no Afghan government agency has either the necessary control over the whole country to mandate grain set asides for use in deficit areas or to transport grain to deficit areas. In addition, individual farmers and local authorities are likely to retain portions of their wheat surpluses as reserves for local use.

And, in the absence of reliable information on transport conditions, no accurate estimate of transport-related losses to wheat stocks can be made. Finally, lack of information on the origins of Afghan refugees settled in Iran, as well as the internally displaced inside Afghanistan, prevent an accurate calculation of the impact of repatriation on wheat availability.

SECTION 4: RECOMMENDATIONS

This wheat availability study demonstrates the use of the ASSP/PSA Geographic Information System to identify areas of Afghanistan where significant wheat shortages are likely to occur in 1992. Several additional steps are required to refine the model and produce the most accurate wheat availability data possible. These steps are discussed below in order of their importance.

Grain Yield Reduction Factors

The wheat production estimates must be adjusted to account for the inability of farmers to plant or harvest crops. The DAI/EarthSat grain production model operates from the assumption that land customarily planted in grain **was planted** in grain during the 1991 growing seasons. CROPCAST and DAI/EarthSat ground cover satellite data were combined with data from the spring 1991 ground truth collection exercise to identify and quantify these areas. No atypical cultivation behaviors, other than those accounted for by the ground truth teams and existing anecdotal evidence, are included in these estimates. The unusually heavy precipitation (snow and rain) rates during 1991, for example, may well have had an effect on ability to harvest the 1990/91 winter wheat crop or to plant the 1991/92 winter wheat crop. The update of meteorological data included a reduction factor (between 10 - 30 percent) for the late onset of rains in the rainfed grain areas. However, farmers in irrigated areas also may have been unable to harvest or plant winter wheat as a result of the rain and subsequent flooding.

All forms of yield reduction must be systematically accounted for to develop accurate wheat production estimates. ASSP/PSA has initiated a survey to collect the relevant data in areas where ASSP/PSA staff work. For areas outside the purview of ASSP/PSA staff, other agency and NGO staff may be able to provide useful information on yield reduction.

Distinguishing Wheat from Poppy

The satellite spectral "signature" for poppy is much like the signature of wheat. The ASSP/PSA 1991 spring ground truth exercise indicated that many of the irrigated crops identified in parts of the eastern and southern provinces as wheat were, in fact, poppy. The DAI/EarthSat team was able to subsequently adjust the wheat production estimates in areas physically identified as poppy cultivation areas. To produce a truly accurate wheat production estimate, the signature for poppy needs to be isolated from the signature for wheat.



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Prepared for the Agricultural Sector Support Project (ASSP)

by

Development Alternatives, Inc. (DAI)

and

The Earth Satellite Corporation (EarthSat)

February 1992